

1 WHAT IS CLAIMED IS:

- 1 1. A method for improving head position accuracy in a disk drive during track
2 following of concentric data storage tracks on a rotating disk's storage surface through real-time
3 identification of external vibration, the method comprising the steps of:
4 seeking to a predetermined data storage track;
5 following the predetermined data storage track using a servo control loop having a
6 nominal gain and being responsive to a position error signal (PES) generated during track
7 following;
8 waiting a vibration detection delay period after the seek to the predetermined data
9 storage track;
10 after the vibration detection delay period, counting occurrences of the PES
11 exceeding a write unsafe (WUS) limit to generate a WUS limit exception count, and determining
12 a property of a variance of a predetermined number of temporally accumulated spectral power
13 values, within a predetermined frequency band, generated from the PES during track following;
14 and
15 increasing the gain of the servo control loop, within the predetermined frequency
16 band, from the nominal gain to a vibration gain, if the WUS limit exception count exceeds a first
17 threshold and if the property of the variance exceeds a second threshold, to attenuate the effect of
18 external vibration on the position of the head during track following.
- 1 2. A method for improving head position accuracy as defined in claim 1, wherein the
2 gain of the servo control loop is increased to the vibration gain for a predetermined vibration
3 time period, after which the gain of the servo control loop is returned to the nominal gain.
- 1 3. A method for improving head position accuracy as defined in claim 2, wherein the
2 vibration time period is between about 1 to 5 seconds.
- 1 4. A method for improving head position accuracy as defined in claim 3, wherein the
2 vibration time period is about 2 seconds.

1 5. A method for improving head position accuracy as defined in claim 1, wherein the
2 gain of the servo control loop remains at the vibration gain during a read operation performed
3 after a write operation.

1 6. A method for improving head position accuracy as defined in claim 1, wherein the
2 gain of the servo control loop remains at the vibration gain after a subsequent seek operation.

1 7. A method for improving head position accuracy as defined in claim 1, wherein the
2 vibration detection delay period is between about one-half ($1/2$) and three-fourths ($3/4$) of one
3 disk rotation.

1 8. A method for improving head position accuracy as defined in claim 1, wherein the
2 vibration detection delay period is about two-thirds ($2/3$) of one disk rotation.

1 9. A method for improving head position accuracy as defined in claim 1, wherein a
2 WUS limit exception occurs when the PES indicates that a read/write head deviates from a
3 desired track position for the predetermined data storage track by more than a predetermined
4 WUS limit during track following.

1 10. A method for improving head position accuracy as defined in claim 1, wherein the
2 property of the variance of the accumulated spectral power values is based on an excursion of the
3 variance of the accumulated spectral power values from a baseline variance value determined
4 with no external vibration present.

1 11. A method for improving head position accuracy as defined in claim 1, wherein the
2 first threshold comprises at least 20 WUS limit exceptions within about 120 position samples
3 based on embedded servo sectors defining the predetermined data storage track.

1 12. A method for improving head position accuracy as defined in claim 1, wherein the
2 predetermined frequency is between about 0 and 500 hertz.

1 13. A disk drive having improved head position accuracy during track following of
2 concentric data storage tracks on a rotating disk's storage surface through real-time identification
3 of external vibration, comprising:

4 means for seeking to a predetermined data storage track;

5 means for following the predetermined data storage track using a servo control
6 loop having a nominal gain and being responsive to a position error signal (PES) generated
7 during track following;

8 means for waiting a vibration detection delay period after the seek to the
9 predetermined data storage track;

10 means for counting occurrences of the PES exceeding a write unsafe (WUS) limit
11 to generate a WUS limit exception count, and for determining a property of a variance of a
12 predetermined number of temporally accumulated spectral power values, within a predetermined
13 frequency band, generated from the PES during track following, after the vibration detection
14 delay period; and

15 means for increasing the gain of the servo control loop, within the predetermined
16 frequency band, from the nominal gain to a vibration gain, if the WUS limit exception count
17 exceeds a first threshold and if the property of the variance exceeds a second threshold, to
18 attenuate the effect of external vibration on the position of the head during track following.

1 14. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein the means for increasing the gain of the servo control loop increases the servo control
3 loop's gain to the vibration gain for a predetermined vibration time period, after which the gain
4 of the servo control loop is returned to the nominal gain.

1 15. A disk drive having improved head position accuracy as defined in claim 14,
2 wherein the vibration time period is between about 1 to 5 seconds.

1 16. A disk drive having improved head position accuracy as defined in claim 15,
2 wherein the vibration time period is about 2 seconds.

1 17. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein means for increasing the gain of the servo control loop maintains the servo control
3 loop's gain at the vibration gain during a read operation performed after a write operation.

1 18. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein means for increasing the gain of the servo control loop maintains the servo control
3 loop's gain at the vibration gain after a subsequent seek operation.

1 19. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein the vibration detection delay period is between about one-half ($1/2$) and three-fourths
3 ($3/4$) of one disk rotation.

1 20. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein the vibration detection delay period is about two-thirds ($2/3$) of one disk rotation.

1 21. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein a WUS limit exception occurs when the PES indicates that a read/write head deviates
3 from a desired track position for the predetermined data storage track by more than a
4 predetermined WUS limit during track following.

1 22. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein the property of the variance of the accumulated spectral power values is based on an
3 excursion of the variance of the accumulated spectral power values from a baseline variance
4 value determined with no external vibration present.

1 23. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein the first threshold comprises at least 20 WUS limit exceptions within about 120 position
3 samples based on embedded servo sectors defining the predetermined data storage track.

1 24. A disk drive having improved head position accuracy as defined in claim 13,
2 wherein the predetermined frequency is between about 0 and 500 hertz.